

CLAIMS

1. A switching regulator converting an input voltage to a predetermined voltage and outputting the
5 predetermined voltage to a load through an output terminal, comprising:

a first switching element including a first control electrode, said first switching element performing switching according to a control signal input to the first control
10 electrode and controlling outputting the input voltage;

a second switching element including a second control electrode having capacitance larger than the capacitance of the first control electrode of the first switching element and an on-resistance smaller than the on-
15 resistance of the first switching element, said second switching element performing switching according to a control signal input to the second control electrode and controlling outputting the input voltage;

a control switching circuit part performing one of
20 a PWM control on both of the first switching element and the second switching element and a PFM control only on the second switching element according to an operating mode so that a voltage output from the output terminal is the predetermined voltage; and

25 a smoothing circuit smoothing a voltage output from

each of the first switching element and the second switching element and outputting the smoothed voltage to the output terminal, wherein when a first operating mode in which the PFM control is performed and the voltage from the output terminal becomes equal to a first voltage is shifted to a second operating mode in which the PWM control is performed and the voltage from the output terminal becomes equal to a second voltage larger than the first voltage, the control switching circuit part increases the voltage from the output terminal stepwise progressively from the first voltage to the second voltage while performing the PWM control.

2. The switching regulator as claimed in claim 1, wherein when shifting from the first operating mode to the second operating mode, said control switching circuit part switches from the PFM control to the PWM control where the output voltage from the output terminal is equal to the first voltage.

3. The switching regulator as claimed in claim 1, further comprising a dummy load in which a predetermined electric current flows, wherein said control switching circuit part connects said dummy load to the output terminal for a predetermined period when the output voltage from the output terminal becomes equal to the second voltage.

4. The switching regulator as claimed in claim 1,
wherein said control switching circuit part comprises:

a PWM control circuit part performing the PWM
5 control on the first switching element;

a PFM control circuit part performing the PFM
control on the second switching element;

a switching circuit part controlling outputting
control signals from each of the PWM control circuit part and
10 the PFM control circuit part to the second control electrode
of the second switching element; and

a control circuit part controlling operations of
the PWM control circuit part, the PFM control circuit part and
the switching circuit part;

15 wherein the control circuit part stops operations
of the PWM control circuit part and directs the switching
circuit part to output the control signal from the PFM control
circuit part exclusively to the second control electrode of
the second switching element in the first operating mode,

20 wherein the control circuit part operates the PWM
control circuit part and directs the switching circuit part to
output the control signal from the PWM control circuit part
exclusively to the second control electrode of the second
switching element in the second operating mode, and

25 wherein the control circuit part increases the

output voltage stepwise progressively from the first voltage to the second voltage where the control circuit part stops the operations of the PFM control circuit part and directs the switching circuit part to output the control signal from the PWM control circuit part exclusively to the second control electrode of the second switching element when shifting from the first operating mode to the second operating mode.

5 5. The switching regulator as claimed in claim 4,
10 further comprising a dummy load in which a predetermined electric current flows, wherein said control circuit part connects said dummy load to the output terminal for a predetermined period when the output voltage from the output terminal becomes equal to the second voltage.

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6. The switching regulator as claimed in claim 1, wherein an electric current flowing into the load in the first operating mode is smaller than the electric current flowing into the load in the second operating mode.

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7. The switching regulator as claimed in claim 1, wherein as a voltage difference between the first voltage and the second voltage becomes large, a number of steps of increasing the output voltage stepwise progressively from the first voltage to the second voltage is increased in said

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control switching circuit part.

8. The switching regulator as claimed in claim 3,
wherein the smoothing circuit part connected to the first
5 switching element in series comprises a switching element for
synchronous rectification, said switching element for
synchronous rectification being controlled by the control
switching circuit when performing switching, and wherein the
first switching element, the second switching element, the
10 control switching circuit part, the switching element for
synchronous rectification and the dummy load are integrated
into an IC.

9. A method for switching an output voltage of a
15 switching regulator, said switching regulator comprising: an
input terminal; an output terminal; a load; a first switching
element including a first control electrode, said first
switching element performing switching according to a control
signal input to the first control electrode and controlling
20 outputting an input voltage; and a second switching element
including a second control electrode having capacitance larger
than the capacitance of the first control electrode of the
first switching element and an on-resistance smaller than the
on-resistance of the first switching element, said second
25 switching element performing switching according to a control

signal input to the second control electrode and controlling outputting the input voltage, wherein said switching regulator is enabled to change the output voltage so as to convert the input signal input from the input terminal into a

5 predetermined voltage and to output the predetermined voltage to the load via the output terminal by performing one of a PWM control on both of the first switching element and the second switching element and a PFM control only on the second switching element according to an operating mode, said method
10 comprising a step of increasing the voltage from the output terminal stepwise progressively from the first voltage to the second voltage while performing the PWM control when a first operating mode in which a PFM control is performed and the voltage from the output terminal becomes a first voltage is
15 shifted to a second operating mode in which a PWM control is performed and the voltage from the output terminal becomes a second voltage larger than the first voltage.

10. The method for switching the output voltage of
20 the switching regulator as claimed in claim 9, said method further comprising a step of switching the PFM control to the PWM control in a state where the output voltage from the output terminal is the first voltage when shifting the first operating mode to the second operating mode.

11. The method for switching the output voltage of the switching regulator as claimed in claim 9, said switching regulator further comprising a dummy load in which a predetermined electric current flows, said method further
5 comprising a step of connecting said dummy load to the output terminal for a predetermined period when the output voltage from the output terminal becomes equal to the second voltage.

12. The method for switching the output voltage of
10 the switching regulator as claimed in claim 9, wherein an electric current flowing into the load in the first operating mode is smaller than the electric current flowing into the load in the second operating mode.

13. The method for switching the output voltage of the switching regulator as claimed in claim 9, said method further comprising a step of increasing a number of steps of increasing the output voltage stepwise progressively from the first voltage to the second voltage as a voltage difference
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20 between the first voltage and the second voltage becomes large.